Original Research

Severe injuries and household catastrophic health expenditure in Vietnam: findings from the Household Living Standard Survey 2014

A. Sepehri [a,*], P.H. Vu [b]

[a] Department of Economics, University of Manitoba, Fort Garry Campus, Winnipeg, Manitoba, R3T 5V5, Canada
[b] School of Banking & Finance, National Economics University, 207 Giai Phong Road, Hanoi, Viet Nam

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ABSTRACT

Objectives: To assess the extent that the presence of severe injuries among rural and urban household members is associated with household catastrophic expenditure.

Study design: Vietnam's Household Living Standard Survey of 2014 was used for this study.

Methods: A two-level (household and community) logistic regression analysis was used to identify factors associated with catastrophic health expenditure.

Results: The incidence of catastrophic health expenditure was significantly higher in rural areas (3.1–11.7%) than in urban areas (1.4–6.1%). Households with members with severe injuries were significantly more likely to incur catastrophic health expenditure than those without severe injuries, and the increase was more pronounced for the rural poor and near poor (5.5–8.7 times) than for the rural rich (1.5–2.5 times). Having at least one inpatient contact at a higher level public hospital increased the risk of catastrophic health expenditure significantly for both rural and urban residents, and the increase was significantly greater among the rural residents than the urban residents. Having more household members with health insurance had little effect on the incidence of catastrophic health expenditure faced by urban residents, while it increased the incidence of catastrophic health expenditure faced by rural residents.

Conclusion: The presence of severe injuries among household members was strongly associated with catastrophic health expenditure. To protect households against the financial consequences of severe injuries, efforts should be directed at injury prevention and strengthening the quality of primary and trauma care at the lower level public health facilities as well as extending the breadth and depths of insurance coverage.

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Introduction

Unintentional injuries are increasing significantly as a public health problem throughout the world, particularly in low- and middle-income countries where the burden of injury-related deaths is greatest and increasing.[1,2] Non-fatal health outcomes present a substantially larger component of the injury burden than fatal outcomes, with a higher number of injuries resulting in the need for critical and costly medical care, potentially lifelong disability, significant psychological trauma, and subsequent financial loss.[3] These medical and non-medical costs present a staggering cost burden to individuals and their families as well as to the medical system, and governments.[3–5]

There is a small but growing literature on costing the burden of unintentional non-fatal injuries on the injured and their families.[3,5–8] According to a recent review of 22 studies of direct medical costs of injury and/or trauma in low- and middle-income countries, the median costs per hospitalization was US$291 or 15% of the gross national product per capita.[5] Costing both direct medical and non-medical costs as well as indirect medical costs (i.e., time and income lost by patients and care givers as a result of injury-related morbidity and disability) increased the costs of injury 14-fold to US$4085 or 97% of the gross national product per capita. The high financial costs of severe injures can potentially lead to catastrophic financial losses and impoverishment, particularly in countries where there is little financial risk protection in the form of health care and sickness and disability insurance.[6,7,9–12] According to a recent study of patients with injuries admitted to a provincial hospital in Vietnam, total costs per case amounted to US$365 (six times higher than the average provincial monthly income, US$57.9), with 26% of the sample experiencing catastrophic health expenditure (CHE).[10] In a study of patients with traffic road injuries admitted to emergency departments of two public hospitals and a large private hospital in Hyderabad, India, almost 22% of the patients experienced CHE from medical expenses, with the odds of CHE increasing by 4.2 times for patients admitted into a private hospital and by 95% for patients with no health insurance. The mean out-of-pocket (OOP) medical expenditure per hospitalization was 2.5 times higher than the average medical expenditure per hospitalization for all illnesses and injuries reported from urban India during the same period. In a recent study of OOP spending in four African countries, the mean inpatient OOP spending was far greater for injuries/accidents than for all illnesses, by 38% in Liberia and 115–178% in the Democratic Republic of the Congo and Namibia.[13] Injury was also found to be a strong predictor of CHE experienced by households in slum communities in Nairobi and Kisumu, Kenya.[14]

Much of the existing literature on estimating injury-related OOP expenditures are either hospital based, focusing on a specific injury presented at a large urban general/specialized public hospital, or rely on small-scale health surveys that they are not nationally representative. Using Vietnam's Household Living Standard Survey (VHLSS) 2014 data and a hierarchical regression analysis, this paper assessed the association between the presence of severe injuries among rural and urban household members and the likelihood of households incurring CHE, while controlling for a wide array of household and community-specific risk factors. An understanding of the financial burden of severe injuries on households is needed to inform the proper design of effective social protection measures to protect vulnerable households from CHE as well as cost-effective injury prevention strategies.

Methods

Data

The data used in this study were from VHLSS 2014, a large, nationally representative sample of about 36,094 providing complete income/expenditure information for 9399 households.[15] The health section of the survey collected detailed information on outpatient and inpatient contacts, and OOP expenditures. The health section of the survey also collected information as a separate module on severe injuries in the past 12 months and the duration of those injuries. A severe injury is defined as an injury that a household member 'had to lie down in place and be taken care of by a bedside caregiver or stop working/studying/participating in normal activities.'

Study variables

Following the methodology proposed by the World Health Organization, CHE (the dependent variable) was defined as an OOP payment for health care that equals or exceeds 40% of the household capacity to pay (total consumption spending minus subsistence need).[16] OOP payment includes consultation, diagnosis, medication, travel, and accommodation. Although there is no consensus regarding the specific threshold above which healthcare expenditures are considered a financial catastrophic, most agree that it should be measured in relation to a household's capacity to pay.[17,18] Given the small number of observations on CHE at the 40% threshold for the urban subsample (39), we also used 30% and 20% thresholds. Subsistence need was defined as the average food expenditure of the households whose food share in total expenditure was in the 45–55 percentile range for the sample as a whole. To account for economies of scale at the level of household, subsistence need was adjusted for household size. However, for households whose total spending was lower than the estimated subsistence need, capacity to pay was taken as the observed non-food expenditure.

It is found that the risk of a household incurring CHE is associated with observed household- and community-specific characteristics, such as having at least one member with self-reported severe injury, having at least one contact at a provincial or central hospital, the proportion of household members with health insurance, household economic status (per capita consumption expenditure quintile), household size, head of household's education and gender, the presence of preschool age children (6 years) and elderly (>60 years) in the household, ethnicity, and geographical region. Definition of these variables and their summary statistics are provided in Table 1.

Table 1 − Definitions and summary statistics (unweighted).			
Variable	Description	Rural (N = 6615)	Urban (N = 2781)
		Mean (std dev.)	Mean (std dev.)
Dependent variables			
Catastrophic health expenditure (CHE)			
CHE 40	= 1 if incurring CHE at 40% threshold, 0 otherwise	0.031 (0.172)	0.014 (0.118)
CHE 30	= 1 if incurring CHE at 30% threshold, 0 otherwise	0.059 (0.235)	0.029 (0.169)
CHE 20	= 1 if incurring CHE at 20% threshold, 0 otherwise	0.117 (0.322)	0.061 (0.240)
Control variables			
Member with a severe injury	= 1 if at least one member reported a severe injury, 0 otherwise	0.206 (0.404)	0.172 (0.377)
Member contacted a provincial hospital	= 1 if at least one member contacted a provincial hospital, 0 otherwise	0.072 (0.258)	0.086 (0.280)
Member contacted a central hospital	= 1 if at least one member contacted a central hospital, 0 otherwise	0.024 (0.152)	0.040 (0.196)
Proportion of household members with health insurance	A continuous variable	0.692 (0.344)	0.723 (0.323)
Household economic status (quintile)			
Expenditure quintiles 1, 2, 3 (poorest) (ref.)	= 1 if expenditure quintile is 1, 2 or 3, 0 otherwise	0.586 (0.493)	0.598 (0.490)
Expenditure quintiles 4, 5 (richest)	= 1 if expenditure quintile is 4 or 5, otherwise	0.414 (0.493)	0.402 (0.490)
Household size			
1−4 (ref.)	= 1 if 4 members or less, 0 otherwise	0.697 (0.460)	0.723 (0.447)
≥5	= 1 if 5 members or more, 0 otherwise	0.303 (0.460)	0.277 (0.447)
Education of the household head			
Primary or less (ref.)	= 1 if primary and less, 0 otherwise	0.552 (0.497)	0.344 (0.475)
Secondary or more	= 1 if secondary and higher, 0 otherwise	0.448 (0.497)	0.656 (0.475)
Gender of household head	= 1 if male-headed household, 0 otherwise	0.786 (0.410)	0.647 (0.478)
Member aged <6 years	= 1 if at least one member is younger than 6, 0 otherwise	0.298 (0.457)	0.288 (0.453)
Member aged >60 years	= 1 if at least one member is older than 60, 0 otherwise	0.303 (0.460)	0.306 (0.461)
Ethnicity	= 1 if a member of ethnic majority Kinh, 0 otherwise	0.787 (0.409)	0.943 (0.232)
Region			
Regions 3, 6, 8[a]	= 1 if household resides in these regions, 0 otherwise	0.340 (0.474)	0.269 (0.443)
Regions 1, 2, 4, 5, 7[a] (ref.)	= 1 if household resides in these regions, 0 otherwise	0.660 (0.474)	0.731 (0.443)

std dev., standard deviation.

[a] Region 1 (Red River Delta); Region 2 (Northeast); Region 3 (Northwest); Region 4 (North Central Coast); Region 5 (South Central Coast); Region 6 (Central Highland); Region 7 (South East); and Region 8 (Mekong Delta).

Statistical analysis

To the extent that the likelihood of incurring CHE is influenced by the unobserved community-specific characteristics, the likelihood of facing CHE is likely to be correlated among the sample population within each sampling cluster or community. For example, households from each sampling cluster might share similar physical, economic, and social circumstances and face similar opportunities and constraints that influence households' health-seeking behavior.[19,20] We used a two-level (household and community) random intercept logistic regression model to assess the association between the likelihood of incurring CHE and the presence of severe injury while controlling for a wide range of the observed household- and community-level characteristics. The likelihood of incurring CHE for household i from community j (y_{ij}) was specified as a function of the presence of at least one severe injury among the household members ($injury_{ij}$) and a set of observed household- and community-specific control variables (x_{ij}):

$$\text{logit}(y_{ij}) = (\alpha + \xi_j) + \beta_1 injury_{ij} + \Sigma_k \beta_k x_{ij} + \varepsilon_{ij} \quad (1)$$

where a was the constant or intercept, ξ_j the random intercept, and ε_{ij} the error term. The random intercept represented the combined effect of all omitted community-level covariates that caused some households incurring CHE.

To assess the extent to which the association between the presence of severe injuries and CHE varies by household economic status, regression Eq. (1) was extended by including a set of interaction terms between $injury_{ij}$ and each household expenditure quintile:

$$\begin{aligned}\text{logit}(y_{ij}) = &(\alpha + \xi j) + \beta_1 injury_{ij} * \text{quintile1} + \beta_2 injury_{ij} \\ &* \text{quintile2} + \beta_3 injury_{ij} * \text{quintile3} \\ &+ \beta_4 injury_{ij} * \text{quintile4} + \beta_5 injury_{ij} * \text{quintile5} \\ &+ \Sigma_k \beta_k x_{ij} + \varepsilon_{ij}\end{aligned} \quad (2)$$

Because the VHLSS data use a three-stage, stratified cluster sampling methodology, standard errors of the estimated coefficients were corrected for potential intra-community correlation (heteroscedasticity) resulting from the clustering of responses by the primary sampling unit. We also applied sampling weights to produce unbiased population estimates. Stata version 14.1 (StataCorp, College Station, TX) was used for all data analysis.

Results

The incidence of self-reported severe injuries was higher among rural households (20.56%) than urban households (17.19%), and the difference was statistically significant at the 1% level (Table 2). Households in the bottom three expenditure quintiles were more likely to report severe injuries than those in the top expenditure quintiles, and the expenditure gradient in the risk of severe injuries was more pronounced in urban areas than in rural areas.

The middle panel of Table 2 reports the proportion of households incurring CHE at various thresholds by place of residence. The proportion of rural households with CHE at the 20% and 30% thresholds were nearly twice that of urban households and 2.2 times at the threshold of 40%.

The lower panel of Table 2 reports the proportion of household members with health insurance by CHE status. While the proportion of household members with health insurance was not significantly different between urban households with CHE and urban households with no CHE, rural households with more insured members were more likely to incur CHE. For example, at the 20% threshold, among rural households with CHE, almost three-quarters of household members were, on average, insured versus 68% for households with no CHE.

The presence of severe injuries was associated with a significantly higher risk of facing CHE (Fig. 1). For example, at the 20% threshold, households with severe injuries were 5.2 times more likely to incur CHE than households with severe injuries in rural areas (32.8 versus 6.3) and by as much as 10.4 times in urban areas (24.3 versus 2.3). These differences were all statistically significant at the 1% level.

The incidence of CHE also varied across expenditure quintiles, with the risk of incurring CHE being significantly higher for the poor (quintile 1) than for the rich (quintile 5) (Fig. 2). For example, at the threshold of 30%, rural households in the bottom two quintiles were 2.2 times more likely to incur CHE than those in the top quintile (7.5% versus 3.4%). These differences were significant at the 1% level. In urban areas, the disparity in CHE incidence between the poor and rich was even greater, with the poor being 4.5 times more likely to incur CHE than the rich (5.6% versus 1.2%). The results for the urban households should be interpreted with care, given the small number of observations, particularly for the non-poor households.

The multilevel logistic regression results for CHE at the threshold levels of 40%, 30%, and 20% are reported for the rural and urban subsamples in Table 3. Given the small number of observations on CHE faced by urban households at the 40% threshold (39), Table 3 reports only the results for rural households at the threshold of 40%. The estimate of intra-

Table 2 − Incidence of severe injuries and catastrophic health expenditure by income quintile and health insurance coverage, Vietnam, 2014 (unweighted).

Variable	Overall	Urban (N = 2781)	Rural (N = 5255)	P-value[a,b]
Proportion of households with self-reported severe injuries				
Total	19.56	17.19	20.56	0.000
Expenditure quintile				
Quintiles 1, 2, 3[c]	20.70	18.51	21.64	0.004
Quintiles 4, 5[c]	17.87	15.22	19.00	0.003
Proportion of households with catastrophic health expenditure				
Catastrophic 40[d]	2.56	1.40	3.05	0.000
Catastrophic 30[e]	5.00	2.95	5.87	0.000
Catastrophic 20[f]	10.06	6.11	11,72	0.000
Proportion of household members with health insurance				
Catastrophic health expenditure				
Catastrophic 30[e]				
Yes	75.35	71.74	76.12	0.297
No	69.88	72.33	68.82	0.000
Catastrophic 20[f]				
Yes	74.18	72.50	74.55	0.461
No	69.71	72.30	68.54	0.000

[a] Chi-squared test to compare the incidence of severe injuries and catastrophic health expenditure among the rural and urban residents.
[b] Independent t-test to compare the proportion of rural and urban household members with health insurance.
[c] Testing for equality of the mean incidence of severe injuries across expenditure quintiles suggested that the bottom three and the top two quintiles could be aggregated in to a single category.
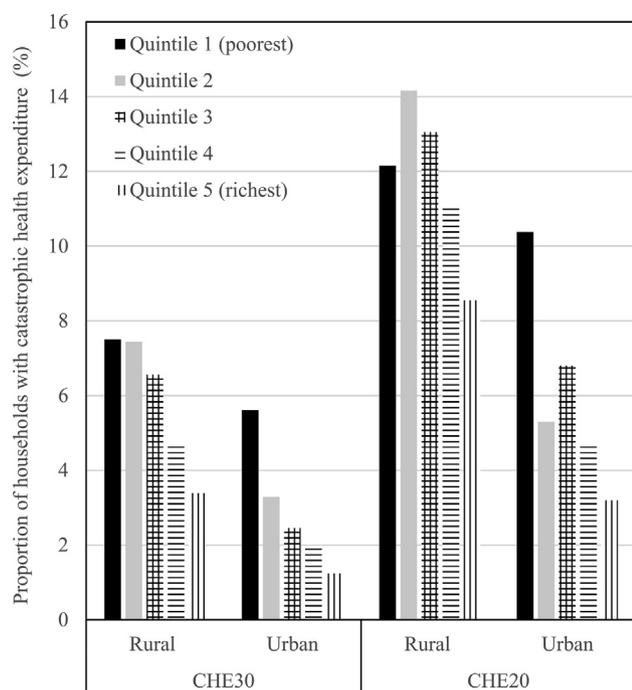[d] Catastrophic health expenditure using a 40% threshold.
[e] Catastrophic health expenditure using a 30% threshold.
[f] Catastrophic health expenditure using a 20% threshold.
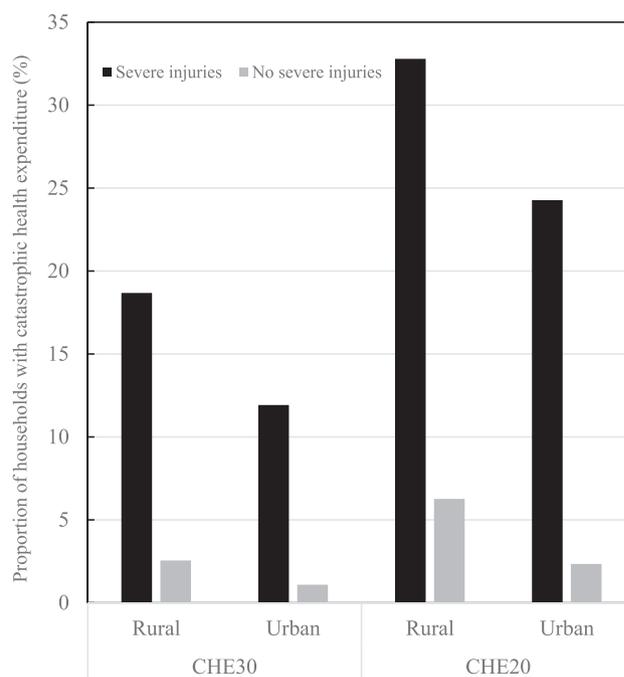
Fig. 1 − Incidence of catastrophic health expenditure (CHE) at the 20% and 30% thresholds among rural and urban households by the presence of severe injuries, Vietnam, 2014.

Fig. 2 – Incidence of catastrophic health expenditure (CHE) at the 20% and 30% thresholds by the place of residence and expenditure quintile, Vietnam, 2014.

household correlation (ρ) continues to remain high and significant, highlighting the importance of some unobserved community-specific risk factors as determinants of CHE.

Overall, the results indicate remarkable consistency in the nature of the association between CHE and its main covariates across the three cutoff points, although the exact magnitudes show some variation. The presence of severe injuries increased significantly the odds of CHE faced by rural and urban households. For example, at the 30% threshold, the presence of severe injuries increased the odds of CHE by 6.3 times for urban households and by 5.4 times for rural households. Having at least one inpatient contact at a higher level public hospital was also a strong predictor of CHE. Households with at least one inpatient contact at a provincial hospital were more likely to experience CHE than those with no contacts, and the increase was more pronounced for rural residents than urban residents. The odds of incurring CHE were significantly greater for contacts at a central hospital than at a provincial hospital, particularly at the threshold level of 20% where rural households with at least one inpatient contact at a central hospital were 12.7 times more likely to face CHE versus 7.6 times for urban households. The proportion of household members with health insurance was positively associated with the risk of incurring CHE, although it was only significant for rural households. Household economic status and household size were also strong predictors of CHE, with households in the top two expenditure quintiles being less likely (45–65%) to incur CHE than those in the bottom three expenditure quintiles. Similarly, the level of education of the household head and the presence of preschool age children in the household had a protective effect, although the magnitude of the coefficients

and their significance varied across various cutoff points and urban and rural areas. The gender of the household head was only significant in the rural subsample, with male-headed households being 39% and 23% less likely to face CHE at the 30% and 20% thresholds, respectively, than female-headed households. Among both urban and rural households, the presence of an elderly member (>60 years old) increased the odds of a household facing CHE. Similarly, ethnic majority households were more likely to experience CHE than ethnic minority households. Regarding geographical regions, residents of the West Northern mountainous region, Central Highlands, and Mekong Delta were significantly more likely to face CHE at the 30% and 20% thresholds than their counterparts in other regions. The regional gradient was more pronounced for urban areas than rural areas.

The results for the interaction terms between severe injury and each expenditure quintile (regression Eq. (2)) at the 30% and 20% thresholds are reported in Table 4. Given the small number of observations on CHE faced by urban households, particularly non-poor households, Table 4 reports only the results for rural households—the results for other regressors were similar to those reported in Table 3 and are available from the authors on request. The presence of severe injuries increased the odds of incurring CHE significantly more for the poor (quintile 1) and near poor (quintile 2) households than for the rich households (quintile 5). For instance, at the threshold of 30%, the presence of severe injuries increased the odds of facing CHE by 8.7 and 6.3 times for the poor and near poor versus 2.5 times for the rich. These differences were statistically significant at the one and 5% level, respectively. By contrast, the corresponding differences in the odds of incurring CHE were not statistically significant for the middle quintiles.

Discussion

Using VHLSS 2014 data and a hierarchical regression analysis, this paper examined the extent to which self-reported severe injuries were associated with the incidence of incurring CHE while controlling for a wide range of observed household- and community-level factors. The results suggest that the incidence of CHE was jointly determined by observed households- and community-level factors as well as unobserved community-level factors. The presence of severe injuries among household members and having at least one inpatient contact at provincial and central hospitals were found to be strong predictors of CHE in both rural and urban areas. Having more household members with health insurance was found to have had little effect on the incidence of catastrophic health expenditure faced by urban residents, while it increased the incidence of catastrophic health expenditure faced by rural residents. Additional analysis of the interaction terms involving injury and household expenditure quintiles suggests that the presence of severe injuries among household members in rural areas increased the odds of incurring CHE significantly more for poor and near poor households than for rich households.

Table 3 – Association between catastrophic health expenditure and socio-economic and demographic factors, Vietnam, 2014.

Variable	aOR (95% CI)				
	40% Threshold	30% Threshold		20% Threshold	
	Rural	Rural	Urban	Rural	Urban
Fixed part					
Member with a severe injury					
None (ref)	1.00	1.00	1.00	1.00	1.00
At least one	8.06 (5.54, 11.72)***	6.39 (4.79, 8.51)***	7.34 (3.80, 14.16)***	5.19 (4.20, 6.41)***	10.68 (6.62, 17.23)***
Member with an inpatient contact at a provincial hospital					
None (ref)	1.00	1.00	1.00	1.00	1.00
At least one	2.58 (1.74, 3.82)***	3.03 (2.15, 4.27)***	2.44 (1.19, 4.98)**	4.39 (3.35, 5.74)***	2.11 (1.19, 3.72)**
Member with an inpatient contact at a central hospital					
None (ref)	1.00	1.00	1.00	1.00	1.00
At least one	6.43 (3.86, 10.71)***	10.31 (6.26, 16.98)***	13.72 (8.62, 21.83)***	8.57 (4.33, 16.97)***	
Proportion of household members with health insurance	2.53 (1.44, 4.43)***	1.46 (0.94, 2.28)*	1.20 (0.50, 2.88)	1.55 (1.14, 2.10)***	1.14 (0.60, 2.16)
Household economic status (quintile)					
Quintiles 1, 2, 3[a,b] (ref)	1.00	1.00	1.00	1.00	1.00
Quintiles 4, 5[a,b]	0.35 (0.24, 0.51)***	0.40 (0.30, 0.52)***	0.43 (0.21, 0.92)**	0.55 (0.45, 0.67)***	0.48 (0.30, 0.76)***
Household size					
<5 (ref)	1.00	1.00	1.00	1.00	1.00
≥5	0.60 (0.42, 0.85)***	0.48 (0.37, 0.63)***	0.50 (0.28, 0.92)**	0.50 (0.40, 0.62)***	0.47 (0.30, 0.74)***
Education of the household head					
Primary and less (ref)	1.00	1.00	1.00	1.00	1.00
Secondary and higher	0.71 (0.55, 1.14)*	0.94 (0.72, 1.22)	0.45 (0.26, 0.77)***	0.79 (0.64, 0.97)**	0.77 (0.49, 1.20)
Gender of the household head					
Male	0.79 (0.55, 1.14)	0.61 (0.47, 0.80)***	0.90 (0.54, 1.52)	0.77 (0.62, 0.95)**	1.11 (0.75, 1.65)
Female (ref)	1.00	1.00	1.00	1.00	1.00
Member aged <6 years					
Yes	0.63 (0.43, 0.91)**	0.84 (0.64, 1.11)	0.91 (0.54, 1.54)	0.82 (0.65, 1.04)	0.76 (0.49, 1.17)
No (ref)	1.00	1.00	1.00	1.00	1.00
Member aged >60 years					
Yes	1.23 (0.87, 1.74)	1.22 (0.92, 1.62)	1.35 (0.79, 2.28)	1.49 (1.21, 1.84)***	1.49 (0.97, 2.30)*
No (ref)	1.00	1.00	1.00	1.00	1.00
Ethnicity					
Kinh	1.93 (1.21, 3.10)***	1.25 (0.86, 1.79)	1.29 (0.51, 3.21)	1.67 (1.26, 2.20)***	1.06 (0.53, 2.09)
Ethnic minority (ref)	1.00	1.00	1.00	1.00	1.00
Regions					
Regions 1, 2, 4, 7[c,d] (ref)	1.00	1.00	1.00	1.00	1.00
Regions 3, 6, 8[c,d]	1.12 (0.78, 1.61)	1.25 (0.93, 1.67)	3.63 (2.15, 6.14)***	1.38 (1.10, 1.71)***	2.86 (1.81, 4.51)***
Random part					
ρ[e]	0.12	0.12	0.03	0.09	0.16
No. of level 1 units	6615	2781			
No. of level 2 units	617	410			

*P < 0.1, **P < 0.05, ***P < 0.01.
aOR, adjusted odds ratio; CI, confidence interval.
[a] Quintile one is the poorest, and quintile 5, the richest.
[b] Testing for equality of the coefficients on the expenditure quintiles suggested that the bottom three quintiles and the top two quintiles could each be aggregated into a single category.
[c] Testing for equality of the coefficients on Vietnam's eight regions suggested that certain regions could be aggregated.
[d] Region 1 (Red River Delta); Region 2 (Northeast); Region 3 (Northwest); Region 4 (North Central Coast); Region 5 (South Central Coast); Region 6 (Central Highland); Region 7 (South East); and Region 8 (Mekong Delta).
[e] Intra-household correlation.

Consistent with previous research, healthcare needs and utilization, particularly inpatient contacts at higher level public health facilities, are strong predictors of CHE.[14,21] In our sample, OOP spending on inpatient care by rural (urban) households with CHE at the 30% threshold accounted for 49.5% (57.1%) of household's total OOP health expenditure as compared with 15% (11.3%) for households with no CHE. The evidence for the association between CHE and health insurance is mixed. Health insurance was found to provide some degree of financial protection against the risk of incurring CHE in some settings,[22−26] no financial protection in other settings,[27−30] and an increase in the risk of incurring CHE in some settings.[31−33] Previous studies attribute the weak performance of Vietnam's social health insurance in financial protection to a wide range of factors, including a poorly working referral system, high OOP spending on prescription

Table 4 — Adjusted odds ratios (aORs) of incurring catastrophic health expenditure by the presence of severe injury and household economic status, rural Vietnam, 2014.[a]

Interaction terms (severe injury X expenditure quintile)	aOR (95% CI)	
	30% Threshold	20% Threshold
Fixed part		
Quintile 1 (poorest)		
No severe injury (ref)	1.00	1.00
At least one	9.65 (6.14, 15.18)***	8.35 (5.78, 12.10)***
Quintile 2		
No severe injury (ref)	1.00	1.00
At least one	7.27 (4.71, 11.21)***	6.46 (4.52, 9.21)***
Quintile 3		
No severe injury (ref)	1.00	1.00
At least one	5.31 (3.52, 8.00)***	4.62 (3.31, 6.44)***
Quintile 4		
No severe injury (ref)	1.00	1.00
At least one	6.28 (3.73, 10.59)***	5.41 (3.79, 7.74)***
Quintile 5 (richest)		
No severe injury (ref)	1.00	1.00
At least one	3.52 (1.93, 6.40)***	2.49 (1.60, 3.89)***

CI, confidence interval.
*$P < 0.1$, **$P < 0.05$, ***$P < 0.01$.
[a] Other regressors correspond to those listed in Table 3.

drugs, informal charges, high prevalence of self-medication, weak governance, and high medical and non-medical expenses incurred by patients outside health facilities.[34,35] Although the health insurance benefits are, in principle, portable, in practice, the referral mechanisms remain ineffective, particularly for rural insured members who can only use health services from commune heath centers or district hospitals where they are registered. The quality of primary and trauma care at lower level public health facilities is often poor, and many of the services such as diagnosis and treatment of non-communicable diseases and trauma care, which should be delivered at the community level, are not actually provided.[34,36,37] Rather than risking lower quality of care and complicated paper work often associated with obtaining a referral, insured patients may bypass lower level referral facilities and pay a higher copayment rate, depending on the level at which they access health care (30% at district hospitals, 50% at provincial hospitals, and 70% at central and tertiary hospitals). Alternatively, the insured may forgo insurance benefits altogether and seek care in the more expensive private sector or even private wards of higher level public hospitals.[38] According to one study, while 73% of those who seek outpatient care at their designated public health facilities used their health insurance cards, only 53% and 55%, respectively, did so when using the higher or lower level public health facilities than their designated public health facility.[38]

Although there are policies and regulations in place to control spending on pharmaceuticals such as limits on the value per prescription or requirements to dispense low-priced generics, these policies and regulations are often ineffective.[34] Only 27% of drugs in the National Essential Medicines Lists are contained in the list of reimbursement drugs covered by social health insurance, and both providers and patients have a strong preference for branded and imported drugs, which tend to be more expensive and not covered by social health insurance.[34] The finding that risk of incurring CHE is greater among rural health insurance enrollees than urban health insurance enrollees may reflect the higher cost of care borne by rural residents when they access higher level health facilities in urban centers. Accessing higher level health facilities in urban centers is likely to expose rural residents to a higher cost resulting from lodging, transportation, and higher copayments, especially when they bypass their designated health facilities.

Our results on the association between CHE and socio-economic and demographic risk factors are generally in line with those reported elsewhere. Consistent with previous research, having preschool age children in the household reduced the risk of facing CHE, whereas having an elderly member (>60 years) increased the risk of CHE.[18,21,27,39] In contrast to small children who are not a frequent cause of high health expenditure, the elderly are the most vulnerable and likely to experience high health expenditure resulting from common chronic conditions.[40] Consistent with previous research, larger household size, higher educated household head, and household economic status offered protection against the risk of CHE.[20,25,41] Finally, the finding that residents of the Northwest, Central Highlands, and Mekong Delta regions were more likely to face CHE than residents of Vietnam's other five regions may reflect Vietnam's wide regional and rural-urban income gaps. The Northwest and Central Highlands regions are Vietnam's most disadvantaged regions with a high density of ethnic minorities. Even though the Mekong Delta region is relatively more prosperous than Vietnam's poor regions, vulnerability to poverty remains particularly high in the Mekong Delta where the near poor are vulnerable to falling back into poverty as a result of economy-wide shocks, such as the effects of climate change on rainfall and temperatures, and idiosyncratic shocks, such as job loss, accidents, death, or illness of a household member.[42]

These findings have important policy implications for healthcare delivery and financing in Vietnam and other developing countries. First, the finding that the presence of severe injuries has a significant effect on a household's likelihood of experiencing CHE, particularly among poor and near poor rural households, highlights the need for a stricter enforcement of existing safety regulations.[43,44] Second, the finding that Vietnam's national health insurance scheme provides no financial protection against the risk of CHE incurred by urban households and that it increases the risk of CHE among rural households calls for policy measures that would extend the breadth and depths of insurance coverage and redesign the tiered coinsurance rates to ensure individuals and their families are adequately protected against the financial consequences of unanticipated health shocks. A more generous insurance scheme may not, however, reduce high OOP spending if systems for monitoring and enforcing quality standards are weak, and government-set schedules for fees provide physicians with a strong incentive to favor high-tech care.[35] Moreover, a more generous insurance scheme may not reduce OOP spending as long as deficient and poor quality of care in general and inadequate trauma resources, in particular, at the community level encourage the insured

patients to bypass them and seek care directly at higher level public hospitals.[34,36,37]

Some caveats are in order. First, although the quality of the data in this study is quite high for a developing country, the data on OOP spending and severity of injuries are subject to recall errors. Second, the simple delineation of the geographical area of residence into urban and rural in our analysis of CHE can be misleading, particularly in the context of a low- and middle-income country such as Vietnam where rapid urbanization often leads to the proliferation of slum and squatter settlements with inadequate environmental infrastructure, health services, and housing. The incidence of CHE was found to be significantly higher among households in slum areas of urban Hanoi (10%) than in non-slum areas (6.6%), as was the incidence of common non-communicable diseases.[27] However, the use of a multilevel-level analysis likely mitigates heterogeneity biases resulting from unobserved community-specific factors.

In conclusion, this study showed that the presence of severe injuries among household members was strongly associated with CHE in both rural and urban areas. The influence of severe injuries on CHE in rural areas was particularly more pronounced for poor and near poor rural households. Having at least one inpatient contact at provincial and central hospitals was also found to be a strong predictor of CHE in both rural and urban areas. Health insurance had little effect on the incidence of CHE faced by urban residents, while it increased the incidence of CHE faced by rural residents. To protect households against the financial consequences of severe injuries, efforts should be directed at injury prevention and strengthen the quality of primary and trauma care at lower level public health facilities as well as extending the breadth and depths of insurance coverage.

Author statements

Ethical approval

This study used de-identified data from Vietnam's General Statistics Office; therefore, no ethical approval was required.

Competing interests

None declared.

Author contributions

The first author conceptualized and designed the study. Both authors participated in statistical analysis, interpretation of results, and revision of the manuscript. Both authors read and approved the manuscript.

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